HOT TOPICS AND NEW TECHNOLOGY IN SPINE SURGERY

Brett A Taylor, MD

TOWN & COUNTRY CROSSING
ORTHOPEDICS

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Disclosure

- Dr. Taylor does not have stock ownership or options in any spine implant companies
- Dr. Taylor does not have a consulting agreement with any spine companies
- Dr. Taylor does not have any relatives or close acquaintances that work for *or* represent spine implant companies
- Dr. Taylor prescribes devices based on medical consideration and patient needs, regardless of benefit from industry

National Trends

- Demographics of work force are challenging
  - Over 60 million workers are 55+
  - 53% of those (32 million) are 65+
  - Aging labor force creates greater risk for injury, longer lost time disabilities and more challenging RTW situations

Missouri Workers Compensation

- Prevailing factor
  - Care must "**flow from**" compensable injury
    - Tillotson case
      - "flows from" injury
    - Hornbeck case
      - Treatment required to cure and relieve effects of injury
  - Treatment may
    - have been required because of a complication from preexisting condition
    - benefit a preexisting condition
    - benefit a non-compensable injury or condition

Worker's Compensation

- Patients with worker's compensation
  - More frequent unsatisfactory outcomes
    - ?Psychosocial secondary gains
    - ?Physically stressful work environment
    - ?Smoking status
    - ?BMI

Worker's Compensation Return to Work

- After 12 weeks of disability 50% of injured workers never return to work
- There can be a disconnect between employer and employee
  - Unaware of work available
  - "Adversarial"

Barriers to Return to Work

- Often no communication between employer and physician
  - Is employer involved with initial clinic visit?
- How does Dr. Taylor decide length of restrictions and time off work?
  - Length of time between doctor visits
  - Set standard and objective end points

Dr. Taylor's Considerations Prior to Spine Surgery

- Conservative treatment often better than surgery
- Psychological factors in workers' compensation patients
- Recovery expectations affect outcomes
- Estimated predictions for outcomes and recovery time
  - Surgical timeline

Worker's Compensation Problem Areas

- Growth of spine fusion surgery over last decade
- "Medicalization" of normal processes such as arthritis and aging
- "Decade of Pain" and rise of chronic pain industry

Reference - Brennan, Frank. "The US Congressional "Decade on Pain Control and Research" 2001-2011: A Review." *Journal of Pain and Palliative Care Pharmacotherapy* (2015): 212-27. Web.

Chronic Pain

- Persistent pain of unexplained nature lasting longer than 3-6 months
- Occurs beyond reasonable time for injury to heal
- Occurs beyond reasonable course of a disease
- Alters physical activity, work, family, and social life in negative way
- Documented nerve changes
- Strong emotional component

Opioids and Spine Surgery

- Drastic increase in opioid use over past decade
- Important to identify “at-risk” patients
  - Opioid dependency
- **Dr. Taylor’s prescription protocol**
  - Imperative for patient accountability
  - Narcotic contract [Lab Testing]
  - Maximum post-op narcotic duration 8 weeks
  - Pre-surgical timeline

Reference - Morris, MD, Brent J., and Hassan R. Mir, MD. "The Opiate Epidemic: Impact on Orthopedic Surgery." *Journal of the American Academy of Orthopedic Surgeons* 23.5 (May 2015): 267-71. Print.

Dr. Taylor's Multimodal Analgesia

- Decreases postop opioid requirements
  - NSAIDS
    - Postoperative Toradol
  - Neuromodulatory agents
    - Gabapentin, Lyrica
  - IV Acetaminophen (Ofirmev)
  - Local anesthesia – Bupivacaine, Exparel

Reference -Kurd, Mark F., Tyler Kreitz, Gregory Schroeder, and Alexander Vaccaro. "The Role of Multimodal Analgesia in Spine Surgery." *American Academy of Orthopedic Surgeons* 25 (2017): 260-68. Print.

Improving Outcomes in Work Comp

- Worker's compensation patients are more litigious than typical patients
- Clinicians role extends well beyond patient evaluation
  - Causation – did occupational injury lead to impairment
  - Impairment – derangement of anatomy or physiology
  - Aggravation – permanent worsening of preexisting condition
  - Exacerbation – temporary worsening of preexisting condition
  - Apportionment – degree disorder resulted for work injury

Reference – Daniels, Allen et. al. *The Role of the Orthopaedic Surgeon in Worker's Compensation Cases.* J Am Acad Orthop Surg 2017; 25: e45-e52. Print.

Physical Exam

- Exaggerated pain behavior
- Ingrained in illness conviction
  - Waddell's Psychological overlay
    - Tenderness
    - Simulation tests
    - Distraction Tests
    - Regional Disturbances
    - Overreaction

Psychological Testing

- Fear Avoidance
- Distress Risk Assessment Model (DRAM)
- Perceived Injustice Scale
- Pain Catastrophizing Scale
- Battery for Health Improvement
  - BHI-2
- Minnesota Multiphasic Personality Inventory Restructured Format
  - MMPI-2RF

Fear Avoidance Model

- Objectively measure pain catastrophizing
- Screen for underlying psychosomatic dysfunction
- Fear Avoidance Questionnaires
  - Work Subscale
  - Physical activity subscale

Fear Avoidance Model

Psychological Testing

- **BHI-2**
  - (Battery for Health Improvement)
    - 2nd Edition
- **MMPI-2 RF**
  - (Minnesota Multiphasic Personality Inventory Restructured Format)
    - 2nd Edition

- **Objectively determine**
  - **Symptom magnification**
  - **Is claimant hiding psychopathology**
  - **Is presentation consistent with mental illness**
  - **Evidence of fraudulent impairment**

Flag Models

- Clinical Red Flags – Biomedical factors
- Clinical Yellow Flags – Psychological or behavioral factors
- Occupational Blue Flags – Social and economic factors
- Socio-occupational Black Flags – Occupational factors

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Reference - Main CJ, Williams AC. ABC of Psychological Medicine. Musculoskeletal pain. *BMJ* 2002 Sep 7;325(7363):534-7. PMC version

TAYLOR Spine TEAM

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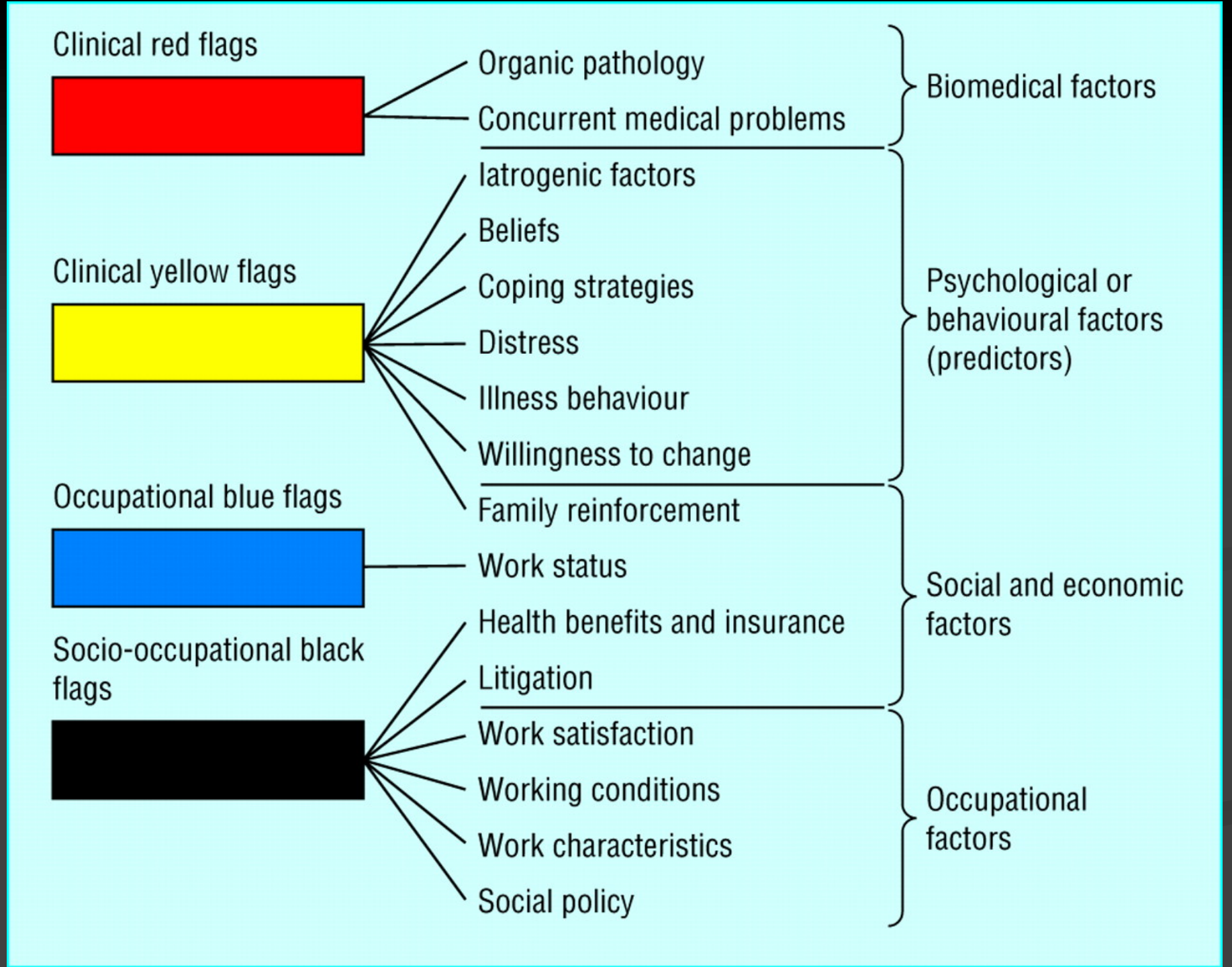


Reference - Main CJ, Williams AC. ABC of Psychological Medicine. Musculoskeletal pain. *BMJ* 2002 Sep 7;325(7362):534-7. PMC version

Biomedical Based Communication

What some doctors say:	What the patient hears:
Your MRI shows degenerative changes/disc herniation/arthritis	I will never get better
There's nothing wrong with your back	He/she thinks it's all in my head
Stop when you feel pain	Activity will harm my back
Take it easy and rest	I should stay in bed
If physical therapy doesn't work you may need surgery	I will need surgery
You should be able to work	He/she thinks I am faking

Psychological Based Communication

What Dr. Taylor says:	What the patient hears:
Your MRI doesn't show anything to worry about	There is nothing seriously wrong with my back
The cause of your back pain may not show up on MRI	My pain is real
You should increase activity as tolerated	Activity is good for me
Your back problem should respond to physical therapy	I probably won't need surgery
Working will not cause damage to your back	I will be able to return to work
There are many things you can do on your own to control your pain	I can learn to handle my pain

Pre-surgical Evaluation

- Pre-surgical Health Questionnaire
- Medical Optimization
  - Vit. D
  - Hgb A1c
  - Nicotine cessation
  - Narcotic cessation

Surgical Outcome Modifiers

- Result in worse postop pain, increased frequency of revision, wound complications, poor outcomes
  - Obesity
  - DM
  - Nicotine
  - Narcotic Addiction

Infection Prevention

- Endogenous Source
  - MRSA / MSSA carrier
  - Reduce bacterial burden
    - Eradication
    - Chlorhexidine Gluconate (CHG)
    - Mupirocin (Bactroban)
    - Sage wipes

Intraoperative Skin Prep

- Duraprep
  - 0.7% available iodine
  - 74% isopropyl alcohol
- Chloraprep
  - 2% chlorhexidine gluconate
  - 70% isopropyl alcohol

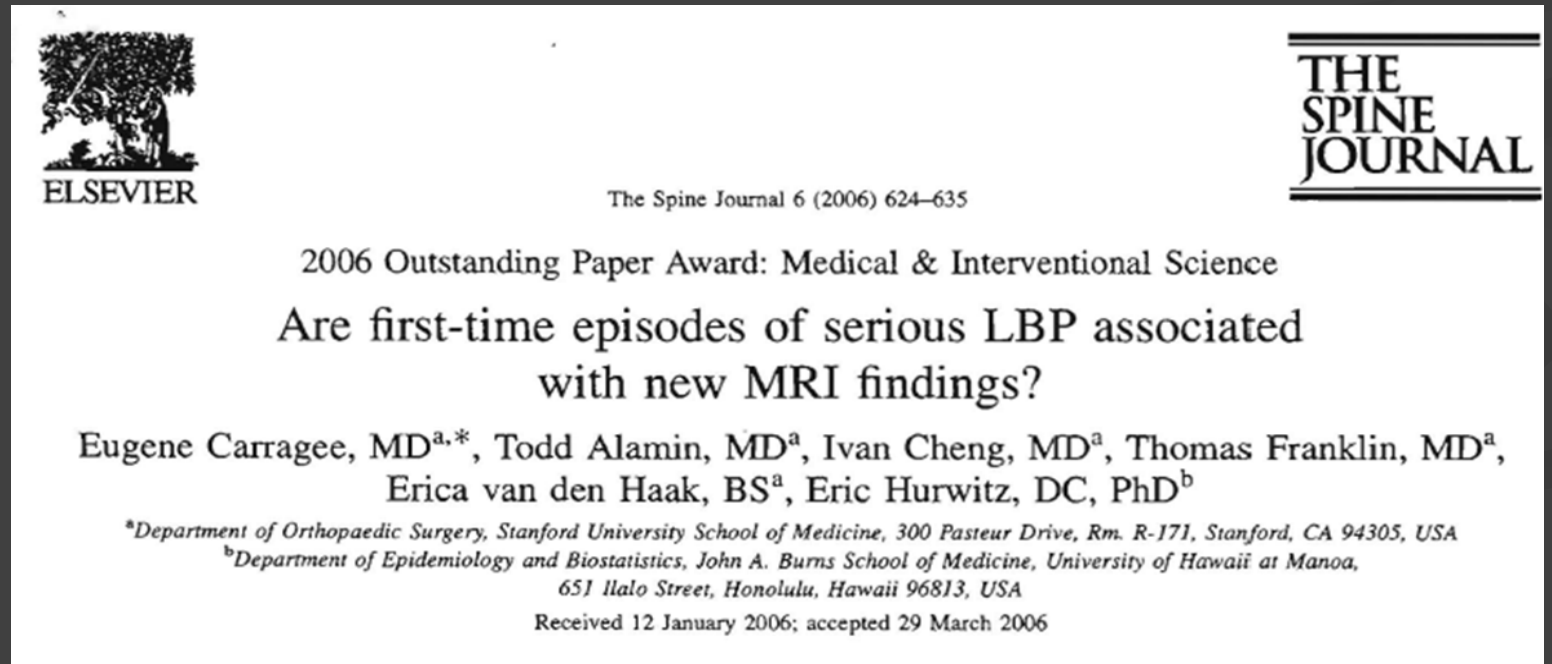
Intraoperative Topical

- Irrisept
- Vancomycin Powder

Common Spine Diagnoses

First-time Low Back Pain and MRI

- Clinical research study shows “NEW” findings on MRI within 12 weeks onset of low back pain are HIGHLY UNLIKELY to represent new structural changes.
  - Changes include loss of signal, facet arthritis, end-plate changes, etc.



ELSEVIER

THE SPINE JOURNAL

The Spine Journal 6 (2006) 624–635

2006 Outstanding Paper Award: Medical & Interventional Science

Are first-time episodes of serious LBP associated with new MRI findings?

Eugene Carragee, MD[a,*], Todd Alamin, MD[a], Ivan Cheng, MD[a], Thomas Franklin, MD[a], Erica van den Haak, BS[a], Eric Hurwitz, DC, PhD[b]

[a]*Department of Orthopaedic Surgery, Stanford University School of Medicine, 300 Pasteur Drive, Rm. R-171, Stanford, CA 94305, USA*
[b]*Department of Epidemiology and Biostatistics, John A. Burns School of Medicine, University of Hawaii at Manoa, 651 Ilalo Street, Honolulu, Hawaii 96813, USA*

Received 12 January 2006; accepted 29 March 2006

MRI Report Variability

- Significant variability in MRI radiologist report findings
- Inaccurate and inconsistent information on MRI reports
- May negatively affect outcome

- **Spine specialist** should evaluate IMAGES AND REPORT
  - Most able to formulate treatment plan including surgery

Reference - Herzog, Richard, Daniel Elgort, Adam Flanders, and Peter Moley. "Variability in Diagnostic Error Rates of 10 MRI Centers Performing Lumbar Spine MRI Examinations on the Same Patient within a 3-week Period." *The Spine Journal* 17 (2017): 554-61. Print.

Pars Defect - Spondylolisthesis

- **Incidental finding in adults**

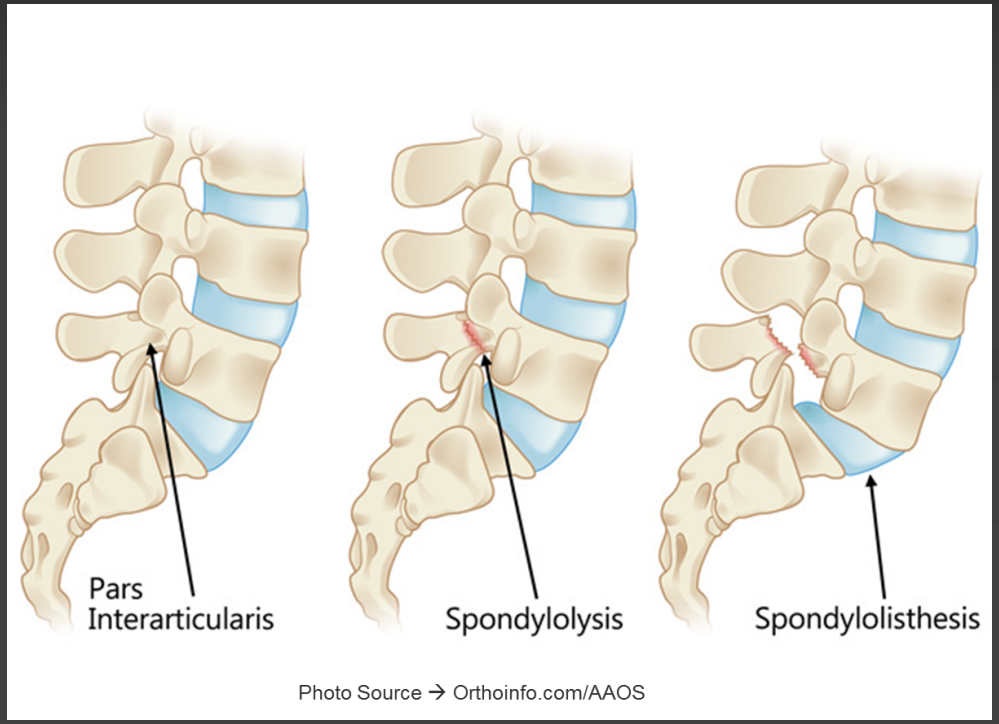
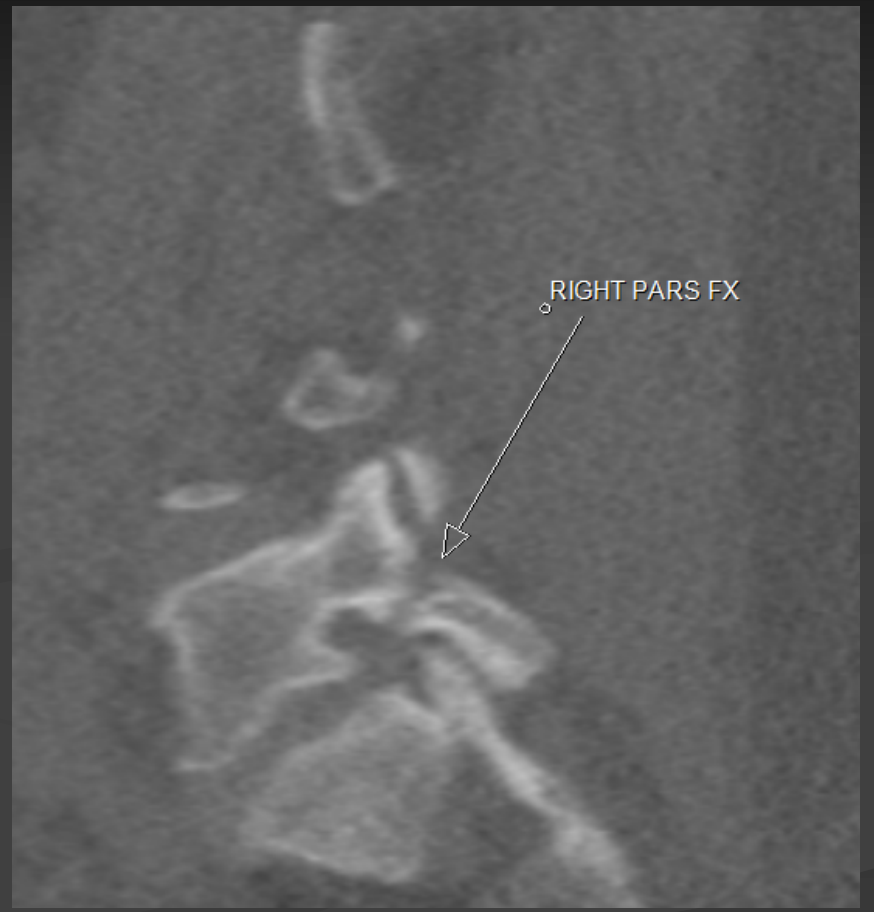


Photo Source → Orthoinfo.com/AAOS



References

1) Lenke, L.G. "Adult Spondylolisthesis with Lysis". The Textbook of Spinal Surgery, 2nd Edition, Vol 2; 1269-1274
2) Hammerberg, Kim, MD and Mustafa Khan. "The Natural History of Spondylolisthesis." The Textbook of Spinal Surgery. Third Edition. Volume 1, Chapter 60 pg: 576-580.

Congenital Spinal Pathology

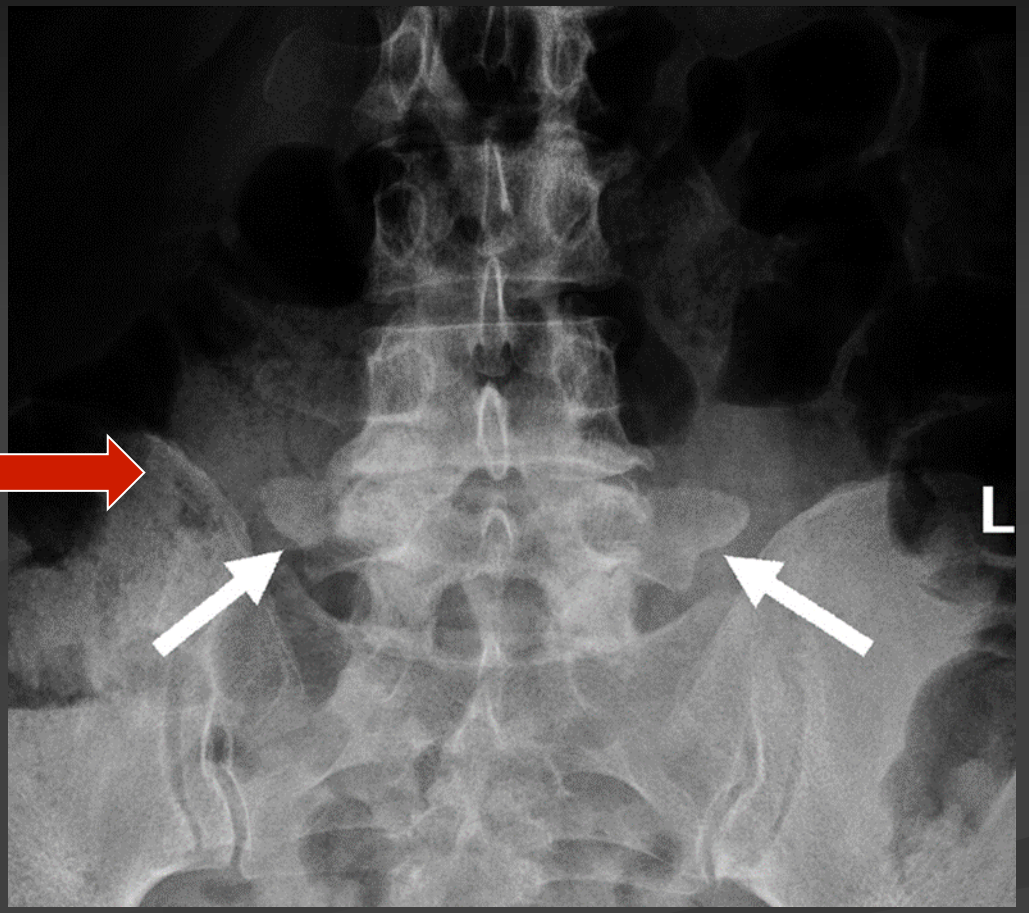
- Present from birth
- Lumbosacral Transitional Vertebrae
  - 36% population
  - Enlargement of L5 transverse process resulting in fusion with sacrum
  - Accelerated degeneration and hypermobility at L4/5
- Klippel – Feil Syndrome
  - Fusion of 2 or more vertebrae in the spine
  - Transition syndrome
    - Accelerated degeneration and hypermobility

Reference - Farshad-A Macker, Nadja A. "Associations between Lumbosacral Transtional Anatomy Types and Degeneration at the Transitional and Adjacent Segments." *The Spine Journal* 15 (2015): 1210-216. Print
Available in Town & Country Crossing Orthopedics Newsletter Volume II

Congenital Spinal Fusion

Klippel – Feil Syndrome
Congenital Fusion C3/C4

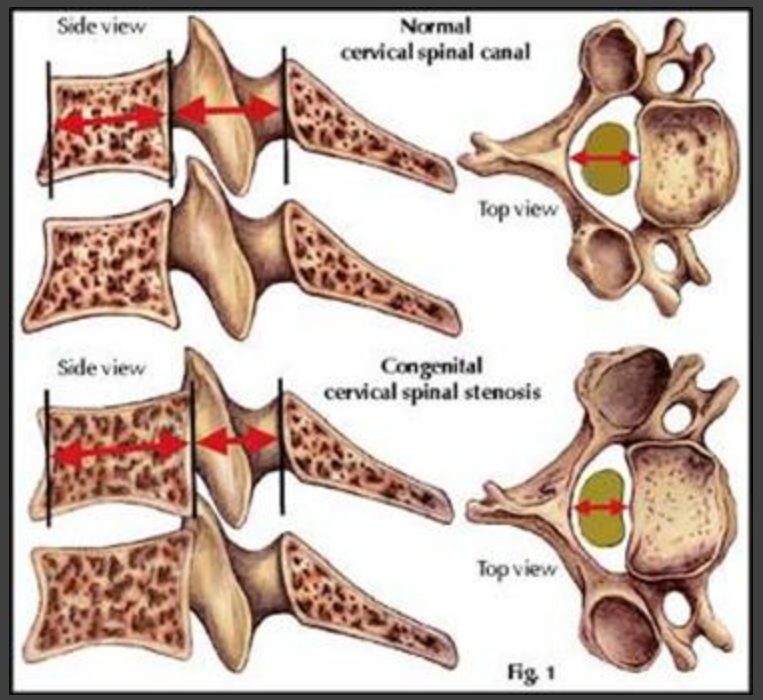
Lumbosacral Transitional
Vertebrae – Enlargement
L5 transverse process

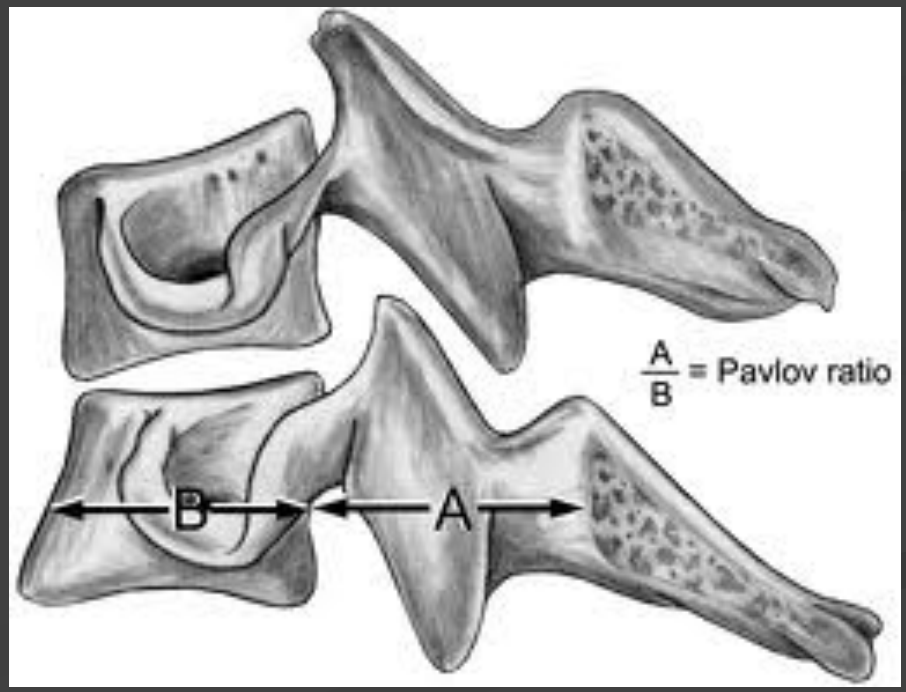


Cervical photo source → South Med J 2005, Lippincott Williams & Wilkins

Congenital cervical stenosis (Pavlov Ratio)

- Ratio of the cervical vertebral body compared to the spinal canal
- Less than 0.82 indicative of congenital cervical stenosis





Congenital lumbar stenosis

- Abnormal development of the spinal canal which predisposes to symptomatic lumbar stenosis
- Patient Demographics
  - 40-50 y/o, male greater than female with a “stocky” build
    - Patients develop symptoms earlier due to canal size
- Primary complaint is low back pain, commonly with activity related symptoms

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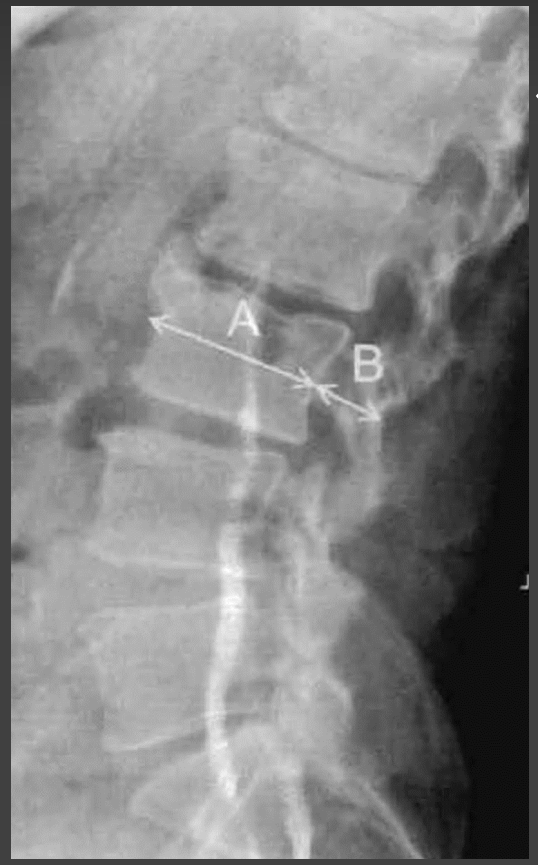
Congenital lumbar stenosis

- Mean Critical Value → ratio of vertebral body length to pedicle length in the lumbar spine

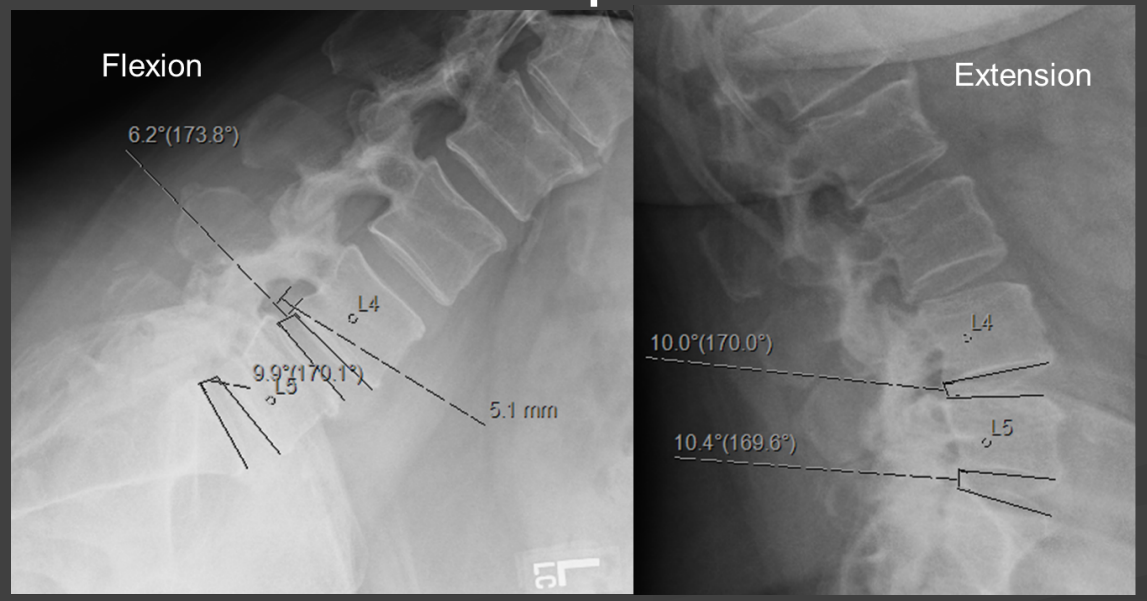


Plain Radiographs
> 0.43

MRI > 0.36

Spine Instability

- Abnormal spinal motion that causes pain and neurologic dysfunction
- Diagnosed with dynamic x-rays (flexion and extension)
- Exists for cervical and lumbar spine



1) Panjabi MM. Clinical spinal instability and low back pain. Journal of Electromyography and Kinesiology 2003; 13:371-379.

2) Vaccaro, Alexander. "Chapter 47: Classification of Lower Cervical Spine Inuries." *The Cervical Spine Research Society*. By D. Greg Anderson. 4th ed. Philadelphia: Lippincott Williams & Wilkens, 2005. 651-70. Print.

Cervical Nonunion

- Pseudarthrosis rate as high as 50%
- “Honeymoon” period from temporary stability
- Implant loosening can lead to clinical deterioration
- CT is best noninvasive study to diagnose nonunion
- Options for revision include anterior or posterior approaches

References - Murar, Jazef, MD. Chioffe, Michael,MD., marquez-Lara, Alejandro MD., and Alpesh A. Patel, MD. “Anterior Cervical Pseudarthrosis.” Contemporary Spine Surgery Volume 16.Number 10.October 2015

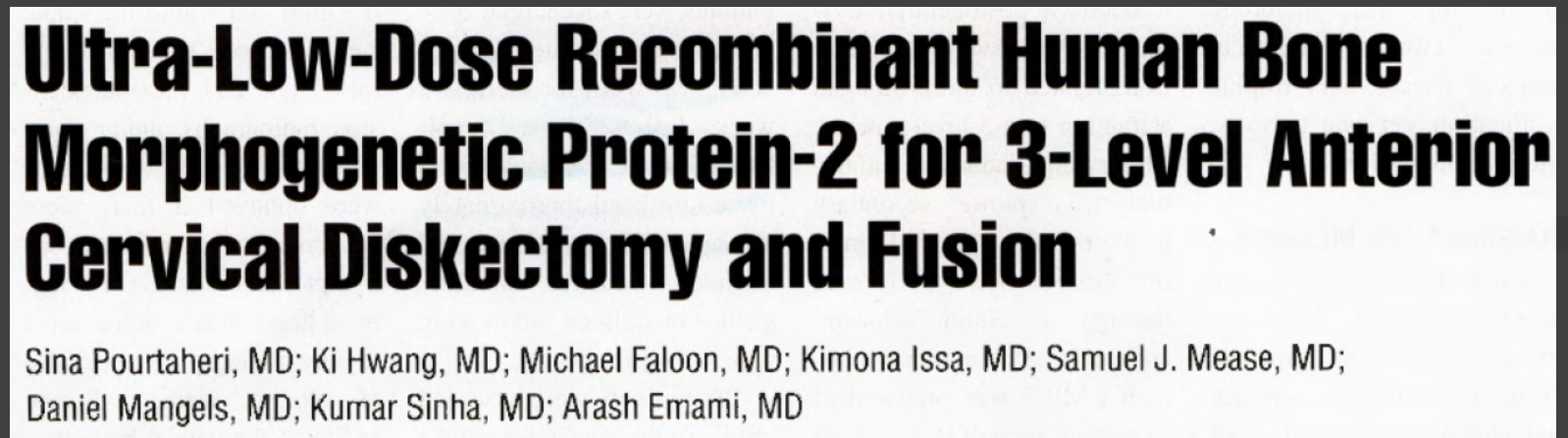
Gruskay, Jordan A, BA;Webb L. Matthew,AB; Grauer N. Jonathan, MD “ Methods of evaluating lumbar and cervical fusion.” The Spine Journal 14 (2014) 531-539

Cervical Fusion Revision

- Ultra-low dose BMP (0.25-0.33mg per level) in the cervical spine
  - Fibrin sealant at operative site
  - Local depomedrol
  - Cervical drain

- **Successful fusion in 97% of patients**

Available in Town & Country Crossing Orthopedics Newsletter Volume II



Ultra-Low-Dose Recombinant Human Bone Morphogenetic Protein-2 for 3-Level Anterior Cervical Diskectomy and Fusion

Sina Pourtaheri, MD; Ki Hwang, MD; Michael Faloon, MD; Kimona Issa, MD; Samuel J. Mease, MD; Daniel Mangels, MD; Kumar Sinha, MD; Arash Emami, MD

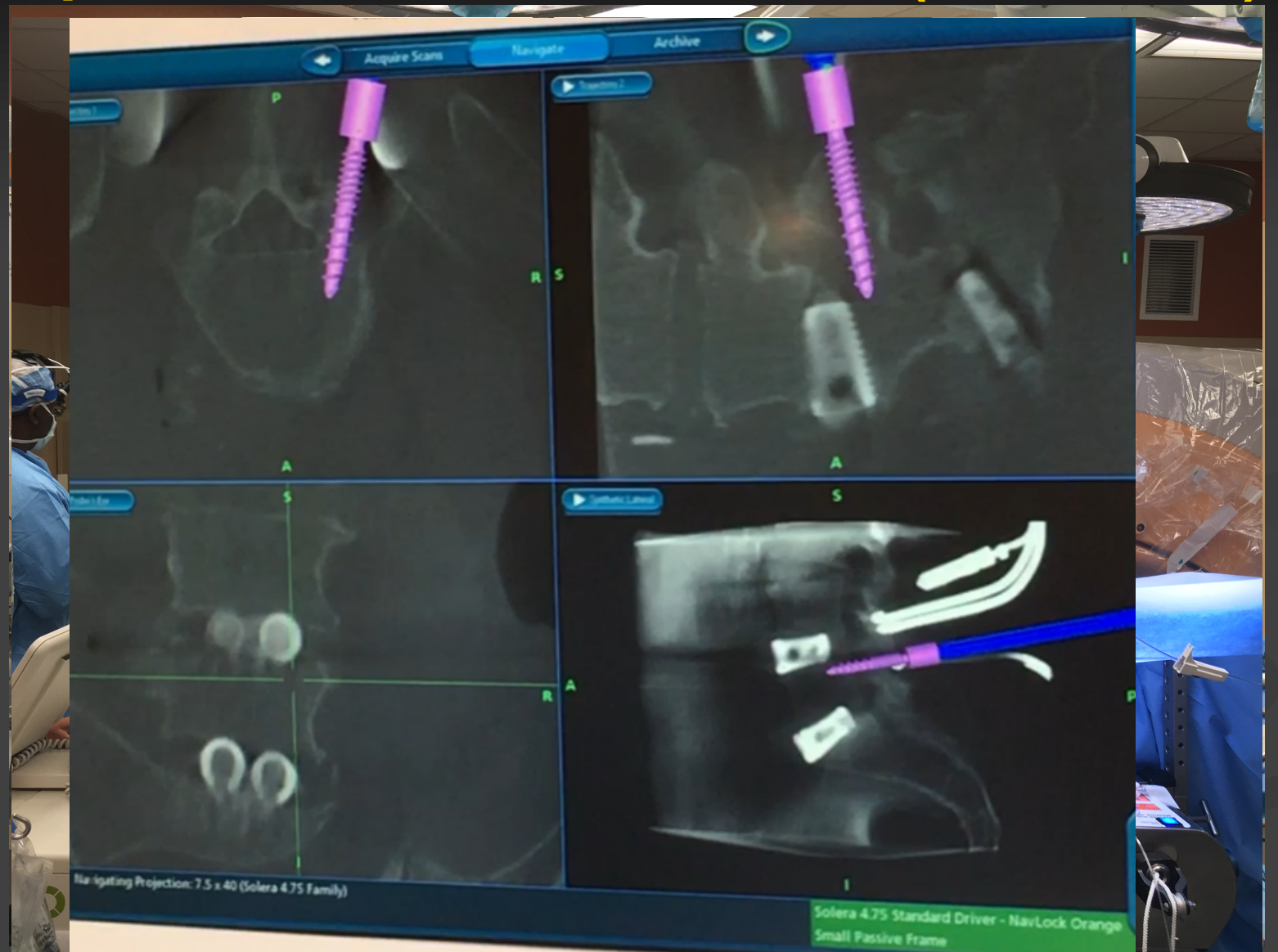
New Technology

- O – Arm
- Aquamantys
- PlasmaBlade
- Irrisept
- Bone Scalpel

Intraoperative CT Scan (O-Arm)

- CT navigation **reduces** surgeon radiation exposure by **2.5x**
- CT navigation MAY reduce the number of postop CT scans
- IMPROVES ACCURACY AND REDUCES COMPLICATIONS WHEN PLACING SCREWS

Intraoperative CT Scan (O-Arm)



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New Technology

- Aquamantys
  - Bipolar Sealer
- PlasmaBlade
  - Cut and coagulation technology with reduced thermal damage
- Irrisept
  - Intraoperative hibiclens irrigation
- Bone Scalpel

Disc Repair

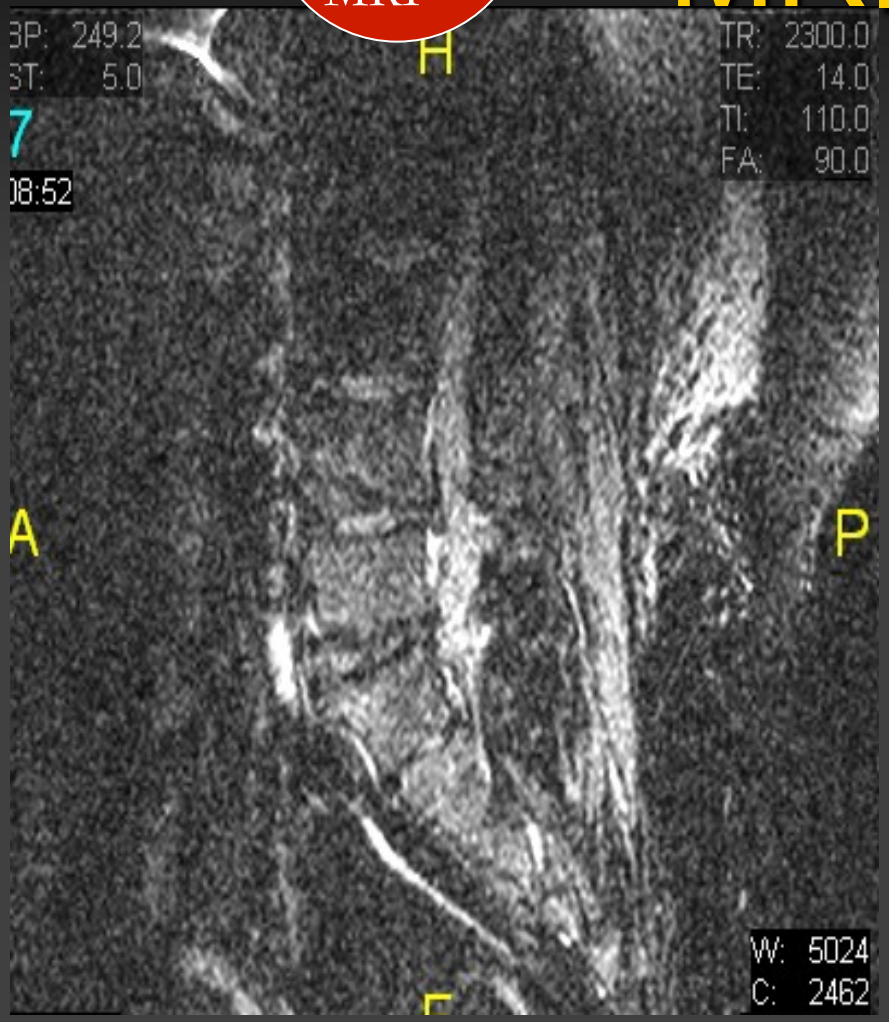
- Cellular Therapy
  - Stem Cell
- Growth Factor Therapy
- Gene Therapy

JURY IS STILL OUT ?

EFFICACIOUS?

New Technology – MRI's not equal

0.6 T Open MRI

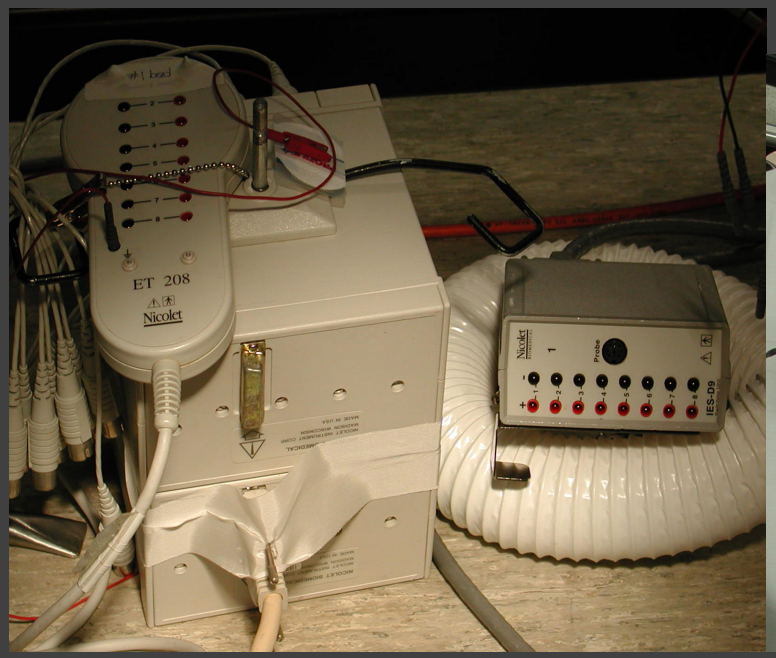


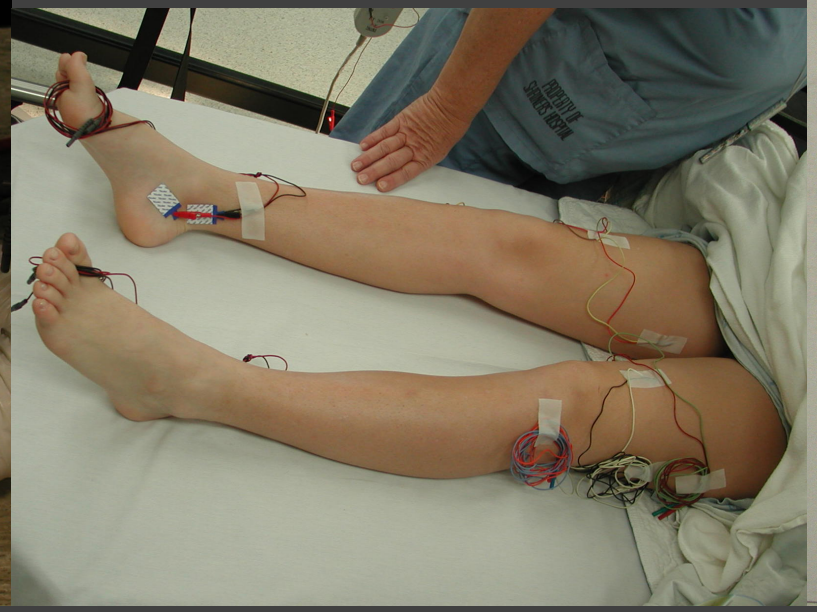
3T Closed MRI

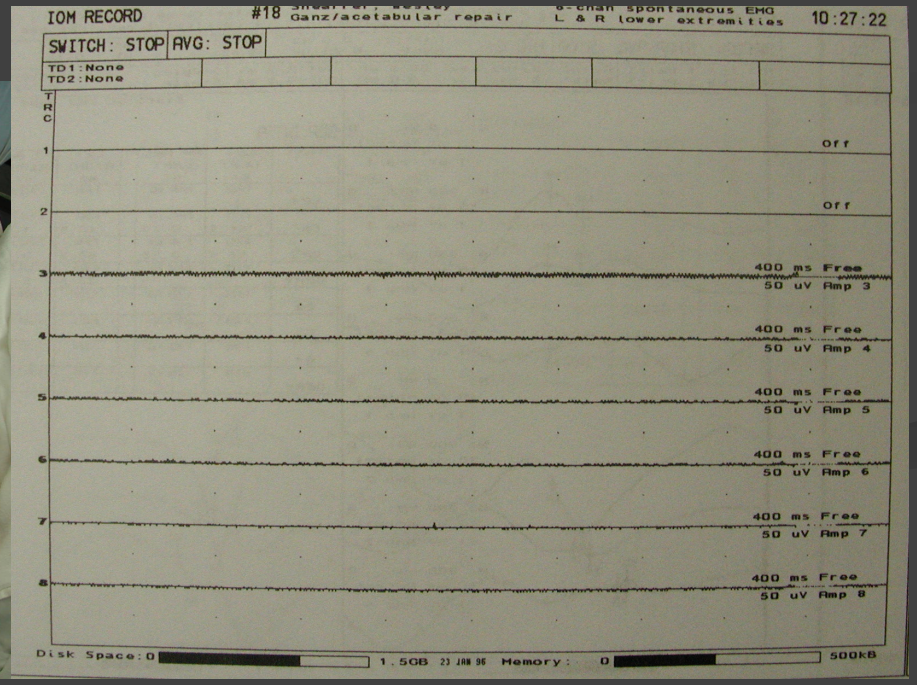
Reference - Herzog, MD, Richard J. "Are All Spine MRI Studies Created Equal? Understanding and Rewarding Quality." The Spine Journal 15 (2015): 2122-125. Print.

NEUROPHYSIOLOGIC MONITORING

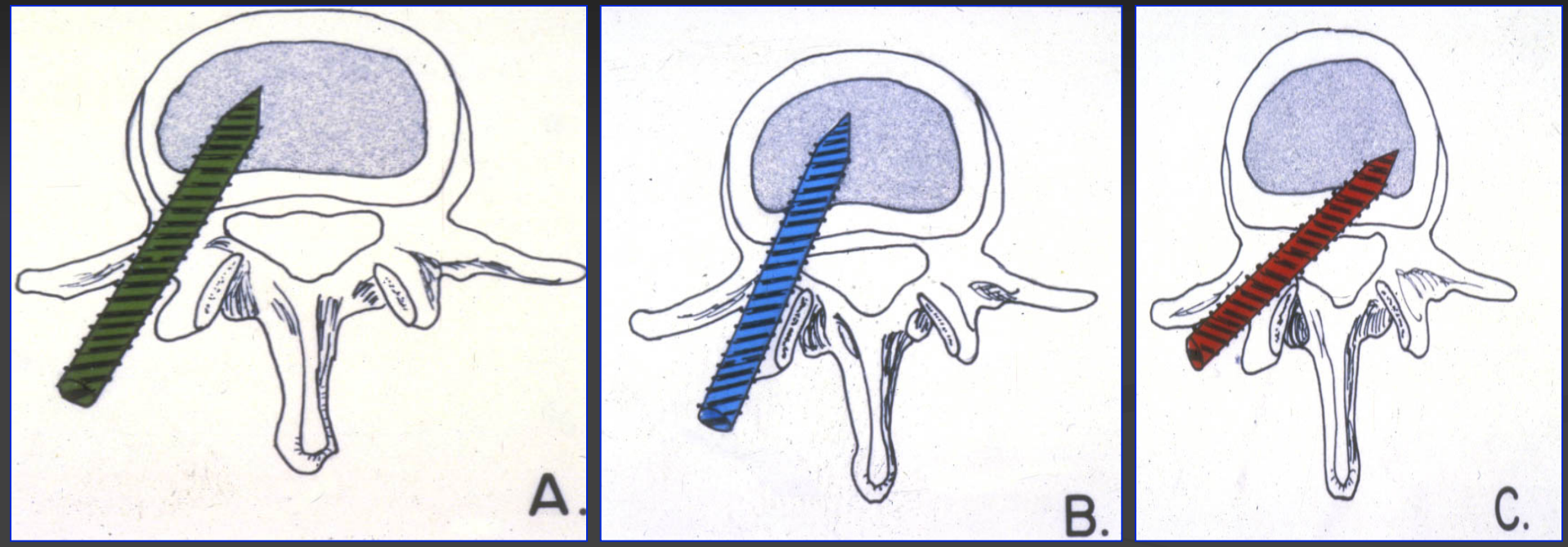
- Utilize intraoperatively to identify nerve root and spinal cord injury during the operation







3 Screw Positions in Lumbar Spine



>8mA **4-8mA** **<4mA**

Reference - Lenke et al., Triggered EMG threshold for accuracy of pedicle screw placement: an animal model and clinical correlation. ***SPINE*** *20(14), 1995*

Taylor Spine Team

- Lori Burke, RN
  - Worker's compensation coordinator
- Joshua Newman, PA-C
  - Board certified physician assistant
- Alyssa Visconti, Administrator
  - Billing specialist
- Laura Milberg, RT(R)
- Rinn Reed, Medical Receptionist
- Kacey McNeely, Medical Assistant

State of Missouri

Office of Administration
Office of Equal Opportunity

Doug Nelson
Commissioner

Walter J. Pearson
Interim Director

This is to certify Town and Country Crossing Orthopedics qualifies as a Minority-Owned Business Enterprise that has met the eligibility criteria established by the State of Missouri, Office of Administration.

Walter J. Pearson, Interim Director, Office of Equal Opportunity

Certification Number 10146 Date of Issue 11/17/2016 Date of Expiration 11/17/2019

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TCCO Clinical Mission Statement

- To provide compassionate and competent high quality patient centered spine care through a respectful provider relationship regardless of patient race, ethnicity, gender or sexual orientation
  - Surgical outcome focus
  - Guideline concordant care
  - Value based care
  - Evidenced based medicine

Patient-Centered Care

- Focus on one patient
- Focused examination
- Provide PERSONALIZED and CUSTOMIZED patient care
  - Increased safety and effectiveness
- Dr. Taylor develops a personalized evidence based care plan to include diagnostics and intervention to optimize spine health

American Academy Orthopedic Surgery Expert Witness Statement

- Truthful
- Thorough
- Fair review
- Accepted standards
- Scientifically based evidence

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AAOS
AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS

Source - http://www.aaos.org/uploadedFiles/PreProduction/About/Professional_Compliance/Expert_Witness_Program/Expert%20Witness%20Affirmation%20Statement.1115.pdf

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Dr. Taylor's Return to Work policy

- Safe and early return to work
- Work hardening/conditioning and FCE's may be used to simulate job demands

- IF THERE ARE NO SUITABLE DUTIES IN WORKPLACE, VOCATIONAL REHAB MAY BE REQUIRED

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AAOS
American Academy of Orthopaedic Surgeons

Source – http://www.jhsph.edu/research/centers-and-institutes/johns-hopkins-education-and-research-center-for-occupational-safety-andhealth/2012pdc_slides/Cloeren_AAOS%20position%20paper%20RTW.pdf

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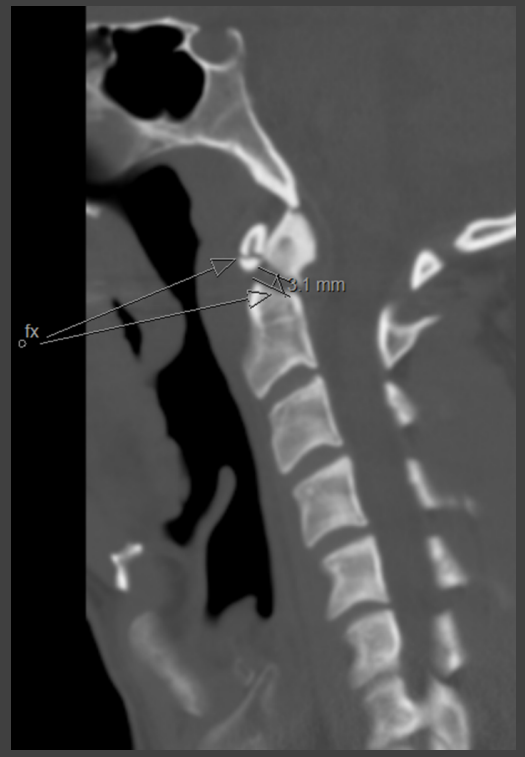
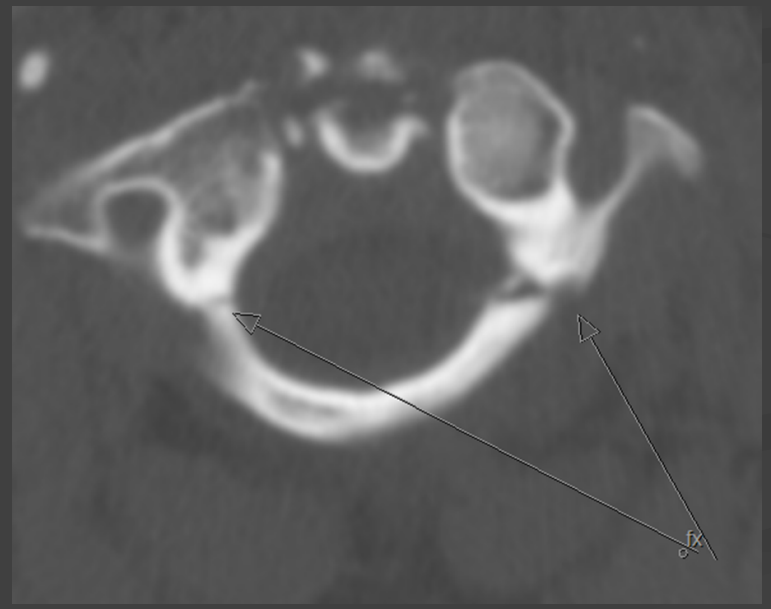
Taylor Spine Team Outcomes in Work Comp

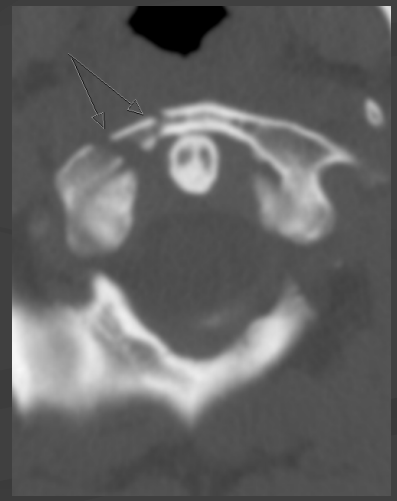
- Data collection – treatment outcomes
- Guideline concordant care (NASS / AAOS)
- Dedicated worker's compensation coordinator
  - Lori Burke, RN
- Over 15 years experience with worker's compensation

Case 1 → C1-C2 PCF

- Blunt trauma to head “broke hardhat”
- CT performed, read as “old united fracture of C1 and C2”







Case 1 → C1-C2 PCF

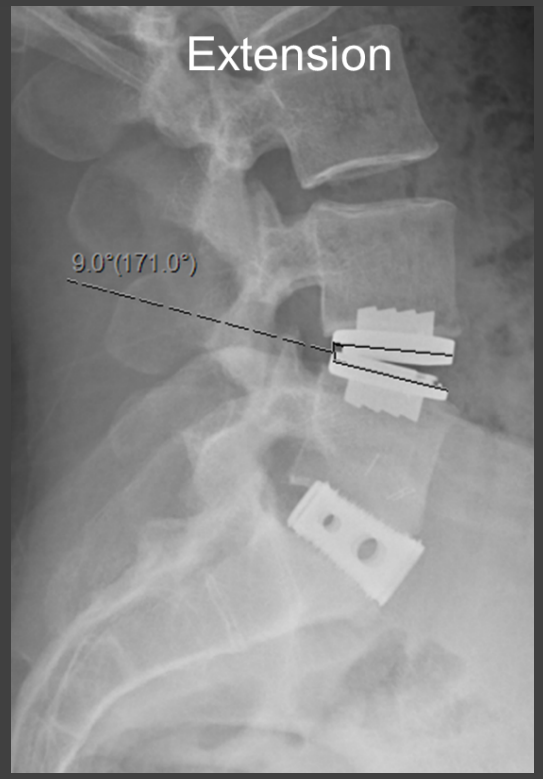
- Presented **5 weeks** after blunt trauma to head
- MRI ordered which identified acute displaced fractures of C1 and C2
- Placed in halo and followed
- C1 successfully fused 3 months post injury
- C1-C2 PCF performed to stabilize C2
- Returned to work in medium demand
  - NDI 28 point improvement

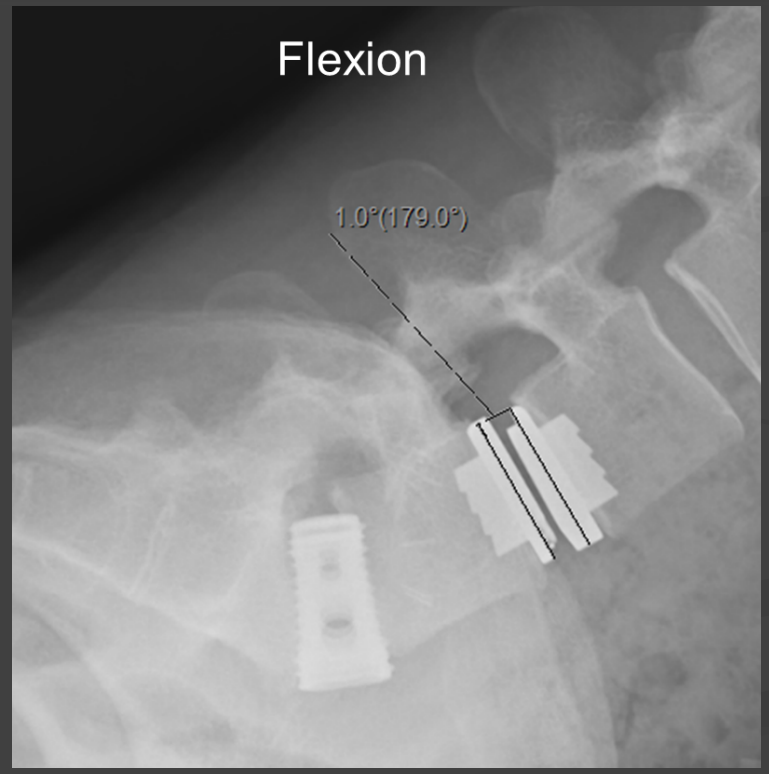
Case 2 → L4-L5 TDR, L5-S1 ALIF

- Work accident resulting in low back and leg pain
- Extensive nonoperative treatment performed – no improvement
  - PT, bracing, meds, injections
- EMG – S1 radiculopathy
  - No facet arthropathy L4/5 on CT
  - Diagnostic L4/5 facet injections → no relief

Case 2 → L4-L5 TDR, L5-S1 ALIF

- Hybrid TDR/Fusion
- 14 point improvement in ODI
- Returned to work full duty (medium)



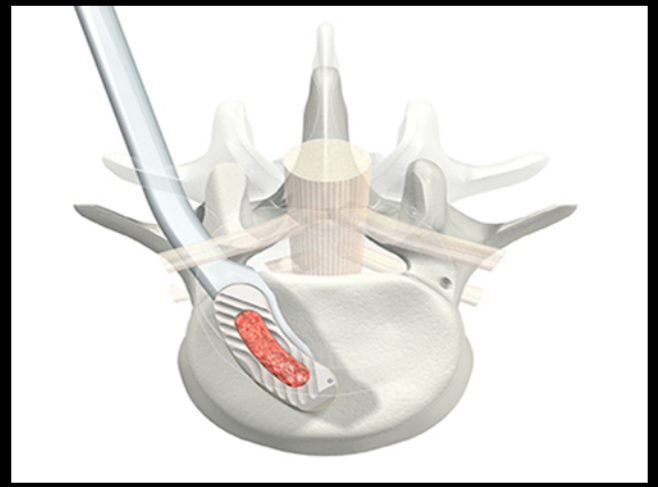


Case 3 → Revision L4-S1 A/P Fusion

TLIF

Transforaminal Lumbar Interbody Fusion

- Small Footprint
- No lordosis correction
- Increased risk of nerve root injury
- Inadequate discectomy / endplate preparation



Case 3 → Revision L4-S1 A/P Fusion

TLIF

Transforaminal Lumbar Interbody Fusion

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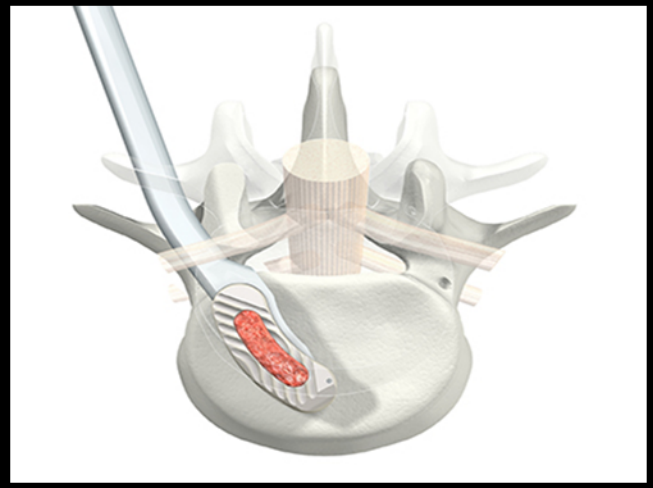
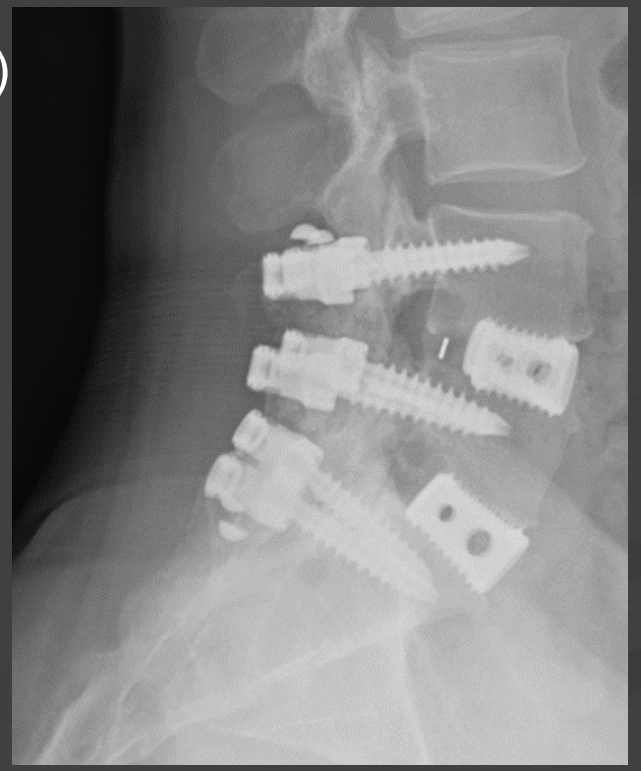
- Increased risk of nerve root injury
- Inadequate discectomy / endplate preparation



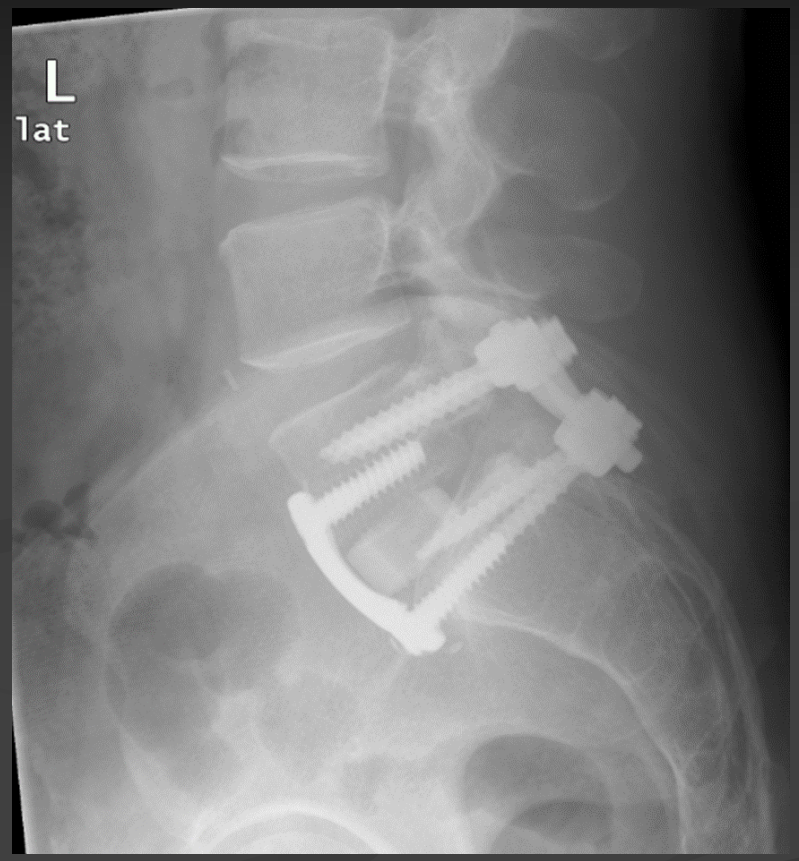
Case 3 → Revision L4-S1 A/P Fusion

- Revision L4-S1 A/P fusion performed
- Fusion confirmed 6 months postoperatively
- MMI ODI – 24 (16 point improvement)
- Returned to work full duty(medium)



Case 4 → Revision A/P Fusion

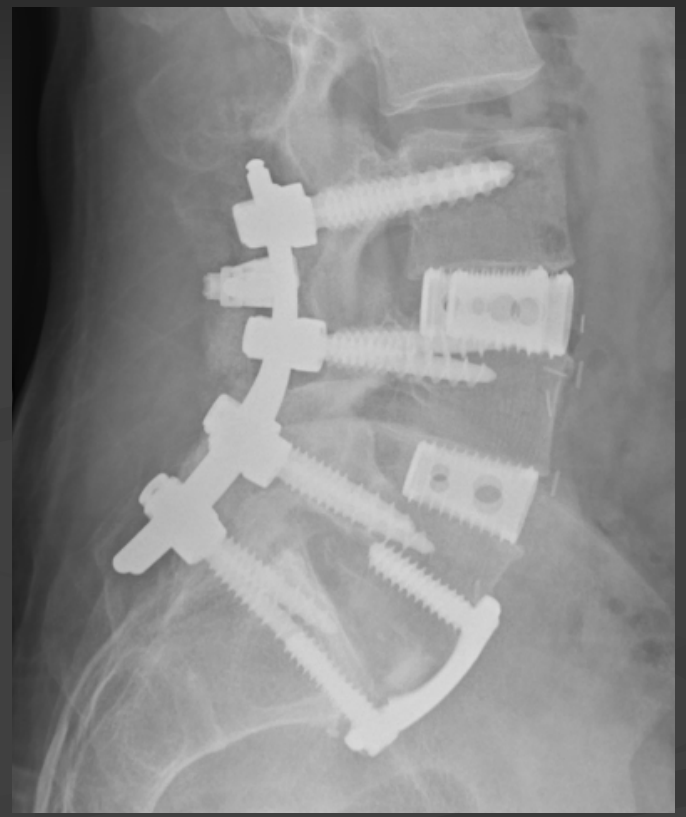
- Presented as IME lumbar spine
- Dx: Instability L4-5, L5-S1, lumbar radiculopathy,
- EMG's ordered → bilateral L5 radiculopathy, left S1 radiculopathy
- BHI/MMPI completed and psych evaluation → cleared



- Dr. Taylor offered L3-S1 A/P fusion
  - *L5-S1 fusion performed by outside surgeon*
  - 1 year postop "worsening symptoms"

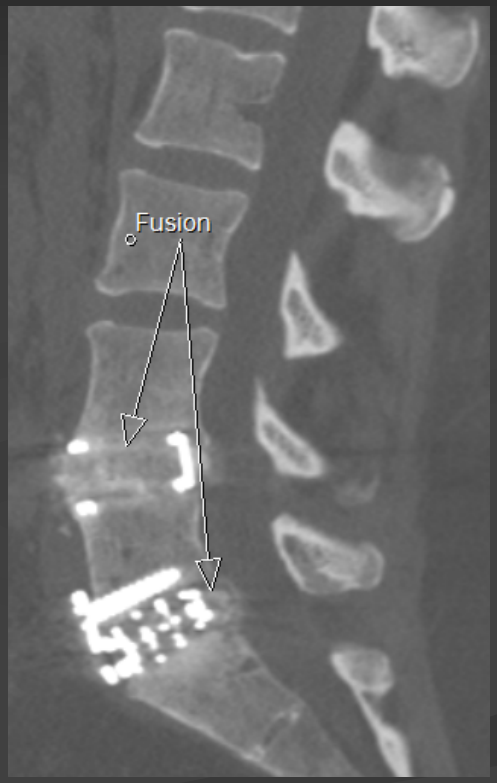
Case 4 → Revision L3-S1 A/P Fusion

- Revision L3-S1 A/P fusion performed
- Returned to work in heavy demand



Case 5 → L4-S1 Stand-alone ALIF

- Presented with low back and bilateral leg pain
- MRI: disc protrusion L5-S1 with stenosis
- Dx: lumbar instability L4-5, L5-S1, radiculopathy
- Failed nonoperative treatment
- RTW 3 months postop
- 32 point improvement in ODI



Taylor Spine Team Cervical Outcomes

Neck Fusion

- Levels – 1 to 4 levels
- MMI NDI – **18 point improvement**
- Average fusion – **4 Months**
- Average return to work –**2 Months**
- Major complications – None
- Infections - None

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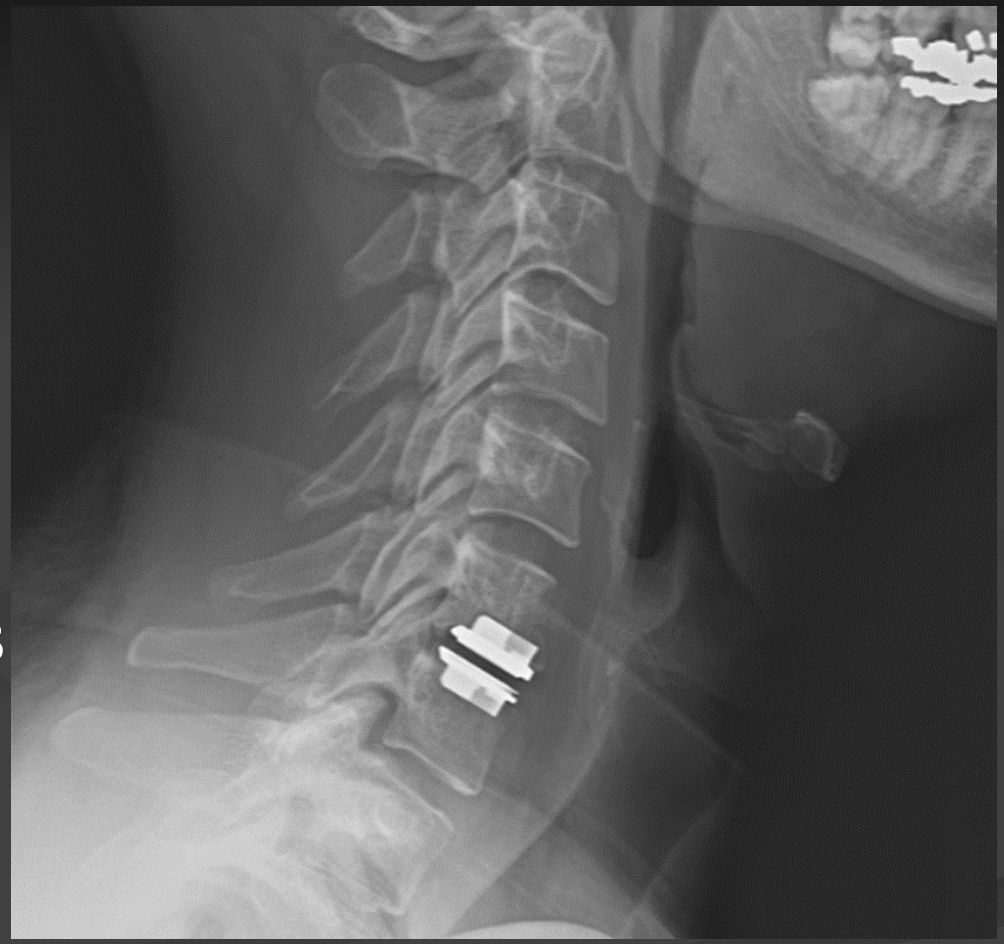
Taylor Spine Team Cervical Outcomes

Cervical Disc Replacement

- Levels – 1 to 3 levels
- MMI Neck Disability Index –**19 point improvement**
- MMI months – **5 months**
- Average months return to work – **2 Months**
- Complications – None
- Infections – None



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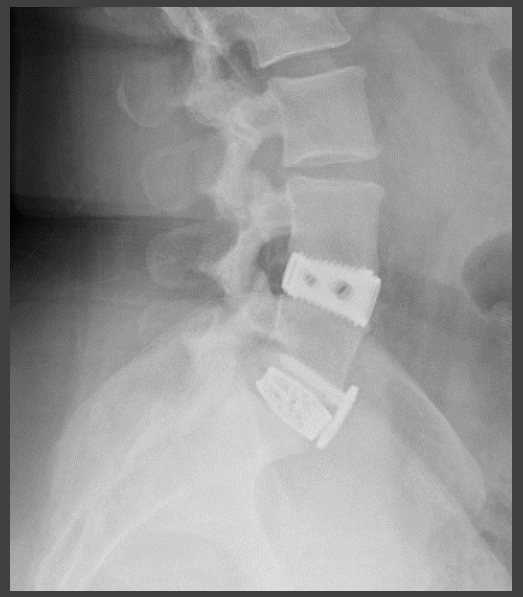
Taylor Spine Team Lumbar Outcomes

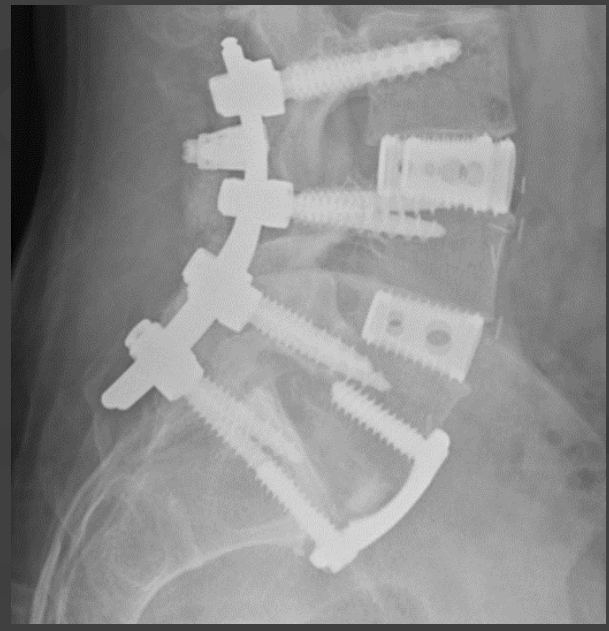
Anterior Lumbar Fusion WITH BMP

- Levels – 1 to 3 levels
- MMI ODI – **22 Point Improvement**
- Average fusion – **4 Months**
- Average return to work – **3 Months**
- Infections – None



Anterior/Posterior Spine Fusion

- Levels – 1 to 3 levels
- MMI ODI – **19 Point Improvement**
- Average fusion – **4 Months**
- Average return to work – **4 Months**
- Infections - None



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Taylor Spine Team Lumbar Outcomes

Lumbar Hybrid TDR/Fusion

- Levels – 2 levels
- MMI ODI – **16 Point Improvement**
- Average fusion – **4 Months**
- Average RTW – **3 Month**
- Infections – None
- Complications - None

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Outpatient Spine Surgery

Total Procedures 2008-2016	
Microdiskectomy	1206
Anterior Lumbar Fusion	850
Posterior Spinal Fusion	531
Anterior Cervical Fusion	914
Posterior Cervical Fusion	61

Adverse Events 2008-2016	
Hospital Transfers	0.1%
Return Surgery	0.2%
Deaths	0
Other Complications	0.8%
Infections	0.2%

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Taylor Spine Team Outcomes in Work Comp

- In network with worker's compensation plans
  - Three Rivers Provider Network, Integrated Health Plan, CorVel, Healthlink

- Office is efficient in providing expedited appointments and timely documentation
  - IME scheduling
  - Same day work status
  - Incorporate imaging/references

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Taylor Spine Team [Telecommunication]

- Aids in the identification of high-risk patients
- Allows for more appropriate allocation of resources with cost reduction
- Reduced readmission rates
- Examples –
  - Facetime/Skype
  - Telephone Communication
  - Text messaging (with de-identified patient information)
    - Example – patient initials only while texting
  - Google Translate

Thank You

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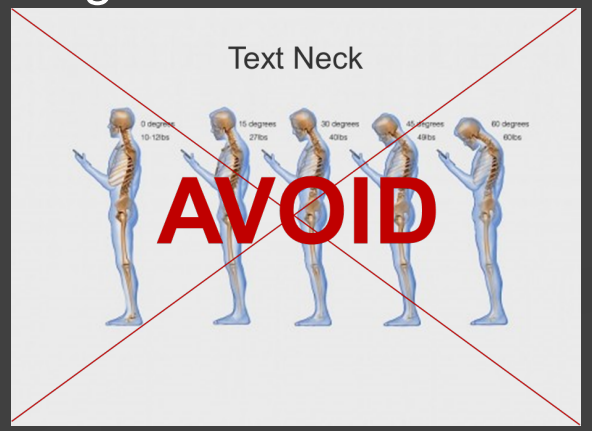
Dr. Taylor's Suggestions for Spine Health

- Do These
  - Vitamin D
  - Exercise
    - Side bridge
    - Weight Training
    - Squats
    - Eccentric Training
    - Balance
    - Walking



- Avoid These
  - NSAIDS/Acetaminophen
  - Sedentary lifestyle
  - Poor diet
  - >3 caffeinated drinks per day
  - Nicotine
  - Too much alcohol
  - Text-neck/back

Taylor Spine Team

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